# Development of an Atmospheric and Space Environmental Models and Simulations Directory

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## INTRODUCTION

The Defense Modeling and Simulation Office (DMSO)[1] is currently developing the Modeling and Simulation Resource Repository (MSRR). The purpose of the MSRR, as defined in their World Wide Web (WWW) site[2], is to provide a "collection of computer resources and information which will assist the Modeling & Simulation Community in communication and information sharing". They also indicate it will be "implemented as a series of WWW servers available through the Internet or the Defense Data Network (DDN)". As part of the MSRR services, there will be a repository of detailed information on the different models and simulations available at the Department of Defense (DoD). This repository of resources will be accessed via the WWW and will allow comprehensive search through the different catalogs and directories. The search will be possible by browsing, entering text, or using a text database query. As part of the MSRR, a network of at least nine servers is contemplated, each dedicated to different information, or modeling and simulation domains.

[1] URL for DMSO is: http: //www.dmso.mil
[2] URL for MSRR information is: http://mercury-www4.nose.mil/msrr/about/whatis.htm

## DEMS/A&S

Our current effort involves the development of a catalog/database of atmospheric and space environmental models to be located under the MSRR. It will be named the Database of Environmental Models and Simulations / Air and Space (DEMS/A&S). In the future, DEMS/A&S will include all key DoD models and simulations related to the air and space natural environments. The information available at DEMS/A&S will be detailed enough to allow users and developers to search the database and determine which models and simulations best apply to the solution of a particular technical problem.

This program was initiated and funded by DMSO, but is being managed by the Executive Agent for Air and Space Natural Environment. The program manager is Mr. Gary B. McWilliams[3], currently located at the Air Force Combat Climatology Center in Scott Air Force Base, IL. DMSO conceived DEMS/A&S as a tri-service program, covering all environmental models and simulations of importance to the three branches of the Armed Forces. As evidence of this approach, DMSO contemplates

[3] Internet address: mcwillig@thunder.safb.af.mil

the addition, in the near future, of models and simulations related to oceans and terrains,

## RELATED EFFORTS: E²DIS AND MEL

DMSO has also sponsored two other major efforts related to DEMS/A&S. These are the Master Environmental Library (MEL) and the Environmental Effects for Distributed Interactive Simulation (E²DIS). As described in their home page, MEL[4] is an MSRR node with a "distributed environmental data access system which allows users to search for, browse, and retrieve environmental data from distributed sources." It is a single-location access to *metadata* or information about all environmental data residing at multiple regional sites. Through the use of keywords, location and time, a user can determine what data is available and where it is located. In addition, facilities for requesting the data are provided.

The E²DIS had eight tasks, one of which included a Survey Task. Burgeson, Piwowar, and Try (1996) report three objectives for the Survey Task: "to develop a baseline of the Military Services' current requirements for incorporation of the atmosphere and near-space environment and their effects in military models and simulations (the Requirements Survey), to identify atmospheric and near-space environmental models and databases that are currently available from the services (the Capabilities Survey), and to compare the results from both survey efforts and make appropriate recommendations." Thus, the emphasis of the E²DIS Survey Task consisted in the identification of current ***requirements*** needed for the ***incorporation*** of data into military models and simulations. As a result, E²DIS studied the gap between model and simulation data requirements and currently available data. It provided recommendations concerning the reduction of the difference between required and available data for models and simulations.

DEMS/A&S uses the excellent and comprehensive information gathered by the E²DIS Survey Task as a starting point for identifying available models and simulations. Additional information is gathered and provided for the models and simulations. Contrary to E²DIS , however, our concern is with providing detailed information about the models and simulations and not with the difference between required and available model data.

## SELECTION CRITERIA

Several selection criteria were developed to accept models and simulations in the DEMS/A&S. Agencies responsible for the development, maintenance, and use of the models and simulations had to follow these guidelines. They were:

1) ***Frequency of use*** - This is an indicator of the importance of a model or simulation. In general, models which are run daily are more important to an agency than those that those run monthly or yearly.

2) ***Model acceptance within the air and space communities*** - Model acceptance within the community can be shown by a formal Independent Validation and Verification (IV&V) process. Many of the environmental models, however, have not gone through this formal process. By their nature, they are in the research and development stage. Model acceptance is shown by the confidence placed by the community of experts who have submitted model physics and results to close scrutiny. When these results are found to be in close agreement with observations, under a wide variety of conditions, the community of experts "accepts" the model or simulation and places confidence in its results.

3) ***Model maintenance*** - The importance of a model to a development agency is indicated by the dedication of resources to maintain a model. Additional evidence for its importance comes from plans to continue model maintenance in the future.

4) ***Activation during crisis or combat*** - Some models which are not run frequently become very important during times of crisis. Their importance to a development agency derives not from the frequency of use, but from the circumstances under in which it is used.

[4] URL for MEL is: http://www-mel.nrlmry.navy.mil/

***5) Education and training*** - Many models and simulations are widely used for education and training purposes. They derive their importance from the function they accomplish and the wide familiarity of the community with them.

***6) Model information - The*** more information that is available about a model, the easier it will be for the community of potential users and developers to evaluate the model's suitability to task. The information will be gathered through site visits, manuals, open literature, or interviews.

## DEMS/A&S ARCHITECTURE

Database structures for DEMS/A&S will be implemented in Oracle V 7.x. It is our intent to maintain the database structure utilizing the latest commercially available versions of Oracle. The design calls for a user-friendly graphical user interface (GUI) that supports diverse functions. A complete set of functions will be available including, among others, browsing, entry, edit, search, sorting and printing.

DEMS/A&S will also seamlessly support various levels of user. Some users will have the privilege of entering or erasing data concerning the model or simulation for which they are responsible. Others will only have access to the information without the capability of changing it. In addition, the capability of storing and showing *classified* information to specific ***authorized*** users will be available. When exploring DEMS/A&S, unauthorized users will not even be aware that classified or sensitive information exists in fields inaccessible to them.

As part of the MSRR network of servers, DEMS/A&S will consist of a Local Area Network (LAN) and a WWW version. Within the MSRR there will be a series of LAN nodes containing databases for the different domains. Figure 1 illustrates, in the outer ring, the different LAN domains. For example, the Army, Navy, Marines, and Ballistic Missile Defense Organization (BMDO) will each have their own Relational DataBase Management System (RDBMS) node. Other organizations, as approved by DMSO, will also have their own LAN RDBMS. DEMS/A&S will be one of the LAN domains, forming part of the local environments domain. In the future, terrain and oceans data will be added as environmental extensions. These LAN nodes will be fully customizable. The organizations responsible for node maintenance will have full control over the information shown locally. In Figure 1, for example, a cost data extension for the Navy domain is presented. Although this data will be available to LAN users, it will NOT be accessible in the WWW version.

Local domains will export and import data to a centralized Oracle RDBMS. This centralized modeling and simulations database will be publicly available in the WWW to users. It is represented as the inner ring in Figure 1. A graphical interface, illustrated in the intermediate ring in Figure 1, will present the information to WWW users. It is important to emphasize that only that data which the LAN administrator specifically wants exported to the WWW will be displayed.

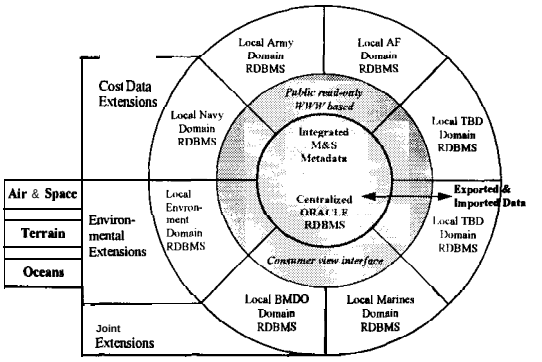


**Figure 1.** MSRR architecture showing the LAN and WWW versions. Local domains are illustrated in the outer ring. The WWW data shown in the inner ring will be displayed to general users through a GUI (intermediate ring).

## LAN AND WWW VERSION PROPERTIES

The LAN version will have the standard Microsoft® look and feel. It will have browser tab views leading to different information categories for the model or simulation. Left-side lists will contain the results of specific queries for models with specific characteristics. These lists and their results will remain available as the

user selects and displays information for the different models. Consequently, there will be no need to conduct the search again as the user moves from one model or simulation to another.

Navigation in the LAN version will be controlled through the use of menus. Access control at the menu, window and tab levels will also be available.

The WWW version will inherit its appearance from the LAN version. As a result, it will have the same look and feel. The WWW version will also have link navigation, taking the user to specific web sites provided by the LAN domains. The general public will only have browsing capabilities in the WWW version. Edit capabilities will only be possible through the LAN domains for authorized **users.**

## INFORMATION ON CANDIDATE MODELS AND SIMULATIONS

Information on the different models and simulations to be included in DEMS/A&S will be acquired through direct site visits of developer facilities. During the visits, developers will be interviewed and they will be requested to fill out questionnaires. In addition, documentation concerning the model or simulation will be collected.

In lieu of, or in addition to direct site visits, model or simulation proponents will be given the option of completing an on-line questionnaire or to submit information by fax, e-mail or regular mail.

DEMS/A&S should be considered as a vehicle to disseminate information regarding models and simulations to the community of users and developers. All information concerning the models belongs to the proponents and will be reviewed by them before it is made available on the WWW. Proponents will also be asked to review the available information periodically to check for its accuracy and to provide updates. As DEMS/A&S developers, we will not generate any information or data about the models that has not been provided by the responsible developing agencies. In addition, we will not supply any code to interested users. That would only be done by the responsible agencies.

## IN-DEPTH EVALUATION

An in-depth evaluation of two models will be performed to characterize their principal algorithms. The purpose of the evaluation is to characterize the model in greater detail. In order to subsequently enhance the database structure and design to best represent all models and simulations. Another important consideration is the exploration of how to best incorporate algorithm information with a view towards facilitating algorithm re-use in the future. Under consideration for this more detailed characterization are an atmospheric mesoscale weather prediction model called the Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS) from the Naval Research Laboratory, Monterey, and GEOspace from Phillips Laboratory, Hanscom AFB.

## STATUS OF DEMS/A&S

The database structure for DEMS/A&S continues to be developed. Although it has substantial similarities to the structure of the other MSRR domains, it will also have unique information tailored to the atmospheric and space models and simulations. An on-line version of the survey questionnaire is available for WWW viewing and entry using standard web browser software. The URL for this WWW version of the survey is available through e-mail ***request*** to either jmedeiro@colsa.com or mcwillig@thunder.safb.af.mil. This method will enable proponents to submit the information about their model or simulation right from their computer without the need to fill out a paper form.

Another activity which is very important to the acquisition of information on models and simulations are site visits. At present several government laboratories have been visited. In the next few months several other installations will be visited where model and simulation developers will be interviewed.

The database is being populated using the information acquired during site visits. For some models and simulations data extracted from the $E^2$DIS study will be used until it can be

updated with more recent information submitted by model developers. In addition, efforts are under way to incorporate the DEMS/A&S data into the WWW application.

It is important that the DEMS/A&S acquire information on as many atmospheric and space environmental models and simulations as possible. We urge the community responsible for the development of atmospheric and space models and simulations to nominate all the relevant models. Nominations should be submitted to mcwillig@thunder.safb.af.mil, medeiro@colsa.tom, or enunez@colsa.com.

In the future, as information on models and simulations, and the algorithms they contain, becomes disseminated through DEMS/A&S, greater use of already existing models and algorithms will be possible. As a result, appreciable monetary and time savings will be possible in the solution of environment-related problems.

REFERENCES

Burgeson, John C., Thomas M. Piwowar, and Paul D. Try, August, 1996. Natural Environmental Effects in Military Models and Simulations: Part II -- A Survey of Capabilities. Report No. PL-TR-96-2040, Phillips Laboratory, Directorate of Geophysics, Hanscom Air Force Base, MA.